

1 POLYAXIAL IMPACT TOOL

2  
3 Field of the Ivention

4 This invention relates to the field of power tools and  
5 more particularly to impact wrenches for turning bolts and nuts  
6 by power assist.

7  
8 Background of the Invention

9 There are many instances in which it is difficult to gain  
10 leverage to apply torque to bolts and/or nuts, usually, because  
11 of the proximity of other structures. In addition to tight  
12 confines of some machinery, there may be the problem of rust  
13 and corrosion adhering the components to each other. In these  
14 circumstances, impact tools are used to apply a large amount of  
15 force with little leverage. Impact tools range from a simple  
16 hammer to air hammers, hydraulic rams and electric ultrasonic  
17 drivers.

18 Concomitantly, it may be impossible to directly apply the  
19 force of the impact tools perpendicularly to the axis of  
20 rotation of the bolts or nuts. In such situations, a link is  
21 required between the impact tool and the bolt to vector the  
22 force. Conventionally, the link is used to vector the force  
23 only in the plane of rotation.

1           U. S. Patent No. 1,923,122 to Smith discloses an impact  
2   wrench driven by an air hammer. A conventional open end wrench  
3   has a spherical socket mounted on one end. A link having a  
4   spherical end and integral arms is rotatably mounted in the  
5   socket. The arms are connected with a pin in the shank of the  
6   wrench. The other end of the link is to be fitted onto the air  
7   hammer. The link can rotate approximately 180 degrees about  
8   the pin in a plane perpendicular to the longitudinal axis of  
9   the bolt or nut being loosened or tightened.

10           McCarthy, U. S. Patent No.1,850,239, discloses a manual  
11   impact wrench having an open end with a shank connected by a  
12   pin such that the shank can rotate approximately 180 degrees in  
13   a plane perpendicular with the longitudinal axis of the bolt.  
14   The end of the shank is formed with a flat surface which may be  
15   struck with a hammer.

16           Blackmore, U. S. Patent No. 4,807,349, discloses an  
17   apparatus and method for breaking frozen or other tight  
18   connections between screw threads by using a rivet gun for  
19   impulses along the longitudinal axis of the bolt while applying  
20   manual rotational force to the threads.

21           U. S. Patent No. 5,161,440 to Jordan discloses a box end  
22   wrench having a shank with a pivoting arm mounted on one end to  
23   pivot in a plane perpendicular to the longitudinal axis of the  
24   bolt. The arm may be attached to a ultrasonic or other

1     vibrational energy source to turn the bolt.

2             What is needed in the art is an impact wrench which can  
3     pivot in the plane of rotation of a bolt and can rotate about  
4     the longitudinal axis of the wrench.

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1     **SUMMARY OF THE PRESENT INVENTION**

2           A polyaxial impact wrench for applying torque to bolts and  
3     nuts. The device has a working end configured to closely  
4     contact the periphery of the head of a bolt or nut. An  
5     elongated shank rigidly extends from the working end. A sleeve  
6     is mounted on the elongated shank for circumferential rotation  
7     about the longitudinal axis of the shank. The sleeve has  
8     having a lock to fix the sleeve at different circumferential  
9     positions about the shank. The sleeve including a means for  
10    connecting an impact tool at different angles to the  
11    longitudinal axis of the shank whereby torque can be supplied  
12    to the working end at varying angles to the longitudinal axis  
13    and circumferentially of the shank.

14           Therefore, it is an objective of this invention to provide  
15    an impact wrench having a working end, an intermediate shank  
16    and a polyaxial power end.

17           It is another objective of this invention to provide the  
18    shank with a power link pivoting in a the plane of rotation of  
19    a bolt attached to the working end.

20           It is a further objective of this invention to provide the  
21    power link with a rotary sleeve adapted to rotate about the  
22    longitudinal axis of the impact wrench.

23           It is yet another objective of this invention to provide  
24    the polyaxial power end of the wrench with a suitable

1 connection for power tools.

2 Other objectives and advantages of this invention will  
3 become apparent from the following description taken in  
4 conjunction with the accompanying drawings wherein are set  
5 forth, by way of illustration and example, certain embodiments  
6 of this invention. The drawings constitute a part of this  
7 specification and include exemplary embodiments of the present  
8 invention and illustrate various objects and features thereof.

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1     **BRIEF DESCRIPTION OF THE DRAWINGS**

2             Fig. 1 is a perspective of the tool of this invention;

3             Fig. 2 is a perspective of the wrench, partially in  
4     section, shank and power end of the tool of this invention;

5             Fig. 3 is a top plan view of pivoting power end;

6             Fig. 4 is a top plan view of an alternative pivoting power  
7     end; and

8             Fig. 5 is a side view, partially in section, of the power  
9     end of Fig. 3.

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1     **DETAILED DESCRIPTION OF THE INVENTION**

2           The polyaxial impact wrench 10, shown in Fig. 1, is  
3     illustrated connected to a manually operated hydraulic pump 11  
4     by line 21.    The impact tool 22 may be fluid operated,  
5     including gas and liquid, or electrically driven.  As shown,  
6     the working end 12 of the wrench is a box end wrench 13 but it  
7     is possible that a ratchet wrench could be employed to provide  
8     torque clockwise or counter-clockwise.  Also, the pump 11 may  
9     have a double acting piston to either push or pull thereby  
10    reversing the torque.  A shank 14 extends longitudinally from  
11    the working end of the wrench.  A shoulder 15 is fixed on the  
12    shank 14 near the working end 12.  The shoulder may have the  
13    shape of a nut with planar intersecting surfaces 16.

14          The sleeve 17 is telescoped over the shank and engages the  
15    shoulder 15.    The front end of the sleeve 17 may be  
16    countersunk.    The counter sunk opening may also have  
17    intersecting planar surfaces 19 complementary with the shoulder  
18    15.    This permits the sleeve 17 to be rotated about the  
19    longitudinal axis of the shank and be selectively rigidly  
20    connected in place by the shoulder and the countersunk  
21    surfaces.

22          As an alternative, the shoulder may be round, as well as  
23    the interior of the countersunk sleeve, so the rotational  
24    position can be infinitely adjustable.  The other end of the

1 shank 14 has screw threads 18 which cooperate with screw  
2 threads in a lock nut 20. The lock nut 20 is tightened to lock  
3 the sleeve against the shoulder. The tightened lock nut  
4 maintains the rotational position of the sleeve. As shown in  
5 Fig. 1, the sleeve 17 has elongated flanges 23 and 24 on  
6 opposed sides. The flanges have a series of connectors 25, 26,  
7 27 spaced along the length. The connectors may be pins,  
8 apertures or bolts which cooperate with a complementary fitting  
9 28 on an impact tool 22 to provide a selectable point to  
10 connect the tool to the wrench 10.

11 Fig. 2 illustrates a sleeve 17 with another connector 40  
12 used to transfer forces from the power tool to the sleeve. In  
13 this embodiment, the sleeve has a plurality of angularly  
14 disposed bores 41, 42, 43 spaced about the circumference of the  
15 sleeve. Each of the bores may be at a different angle to the  
16 longitudinal axis of the sleeve. A complementary fitting 28 on  
17 the power tool including a pin, is inserted into whichever bore  
18 is accessible once the wrench is mounted on the bolt N. Torque  
19 may be applied to the nut through whatever vector is available  
20 in both the plane of rotation of the nut N and a perpendicular  
21 plane. In this manner, torque is adjustable polyaxially in  
22 both planes.

23 The sleeve 17 may have only one flange 23, as shown in  
24 Fig.s 3, 4 and 5. Also, the flange 23 may be formed in an

1     arcuate shape with the power connector 60 in the center of the  
2     arc. Spaced about the arcuate periphery of the flange 23 are  
3     retainers 30 to provide different angular vectors of the power  
4     tool and the wrench in the plane of rotation of the nut N. The  
5     power tool 22 is connected by the complementary fitting 28 to  
6     a retainer 30 and the power connector 60 to maintain the force  
7     vector. As shown in Fig.s 3 and 5, the connectors are in the  
8     form of pins 30 that extend through apertures in the flange 23.

9             In Fig. 4, the arcuate flange 23 has a series of detents  
10     50, 51, 52 in the periphery into which a pawl 53 reciprocates.  
11     The complementary fitting 28 also connects with the power  
12     connector 60 to provide different force vectors around the nut  
13     N in the horizontal plane. Also shown in Fig. 4 is a hollow  
14     adapter 59 telescoped over the complementary fitting 28 in  
15     order to extend the distance between the power tool 22 and the  
16     wrench 10.

17             A number of embodiments of the present invention have been  
18     described. Nevertheless, it will be understood that various  
19     modifications may be made without departing from the spirit and  
20     scope of the invention. Accordingly, it is to be understood  
21     that the invention is not to be limited by the specific  
22     illustrated embodiment but only by the scope of the appended  
23     claims.

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